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PATENT APPLICATION
Do. No. 5038-049

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: MORLEY et al.

Serial No. 09/753,361 Examiner: Karabi Guharay

Confirmation No. 9715

Filed: December 29, 2000 Group Art Unit: 2879

For: FLAT PANEL COLOR DISPLAY WITH ENHANCED BRIGHTNESS AND PREFERENTIAL VIEWING ANGLES

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION TO OVERCOME A CITED PUBLICATION (37 C.F.R. 1.131)

1. The persons making this declaration are Roland M. Morley, Robert C. Sundahl, and Dan Seligson, inventors of the above-referenced patent application ("Application").

2. Certain claims of U.S. Patent Application Ser. No. 09/753,361 are currently rejected in view of certain prior art, *inter alia*, U.S. Pat. No. 6,345,903 (Koike et al.) and U.S. Pat. No. 6,330,111 (Myers). Koike has a filing date ("Effective Date") of September 1, 2000 and Myers has a filing date of August 17, 2000.

3. Conception of the invention that is the subject of the claims in the present application occurred prior to the Effective Dates of the Koike and Myers patents as evidenced by the attached Invention Disclosure document (Exhibit A) submitted internally at Intel on February 14, 2000.

4. Work on the invention was conducted continuously from a date prior to the Effective Date, until the date of filing of the above referenced patent application, and thereafter.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Roland M. Morley

Dated: 1/14/04

Robert C. Sundahl

Dated: _____

Dan Seligson

Dated: _____

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INTEL INVENTION DISCLOSURE

FEB 17 2000

DATE: 10/28/99 CPD Comm / CPD

It is important to provide accurate and detailed information on this form. The information will be used to evaluate your invention for possible filing as a patent application. When completed, please return this form to the Legal Department at JF3-147. If you have any questions, please call 264-0444 or 264-1476.

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   Supervisor* WWID Phone M/S:

(PROVIDE SAME INFORMATION AS ABOVE FOR EACH ADDITIONAL INVENTOR)

2. Title of Invention: Flat panel color display with enhanced brightness and preferential viewing angles

3. What technology/product/process (code name) does it relate to (be specific if you can): Display technology development and Optics

4. Stage of development (i.e. % complete, simulations done, test chips if any, etc.) Concept stage, early development

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PATENT DATABASE GROUP
INTEL LEGAL TEAM

5. (a) Has a description of your invention been, or will it shortly be, published outside Intel:
   NO: X YES: If YES, was the manuscript submitted for pre-publication approval?
   IDENTIFY THE PUBLICATION AND THE DATE PUBLISHED:

   (b) Has your invention been used/sold or planned to be used/sold by Intel or others?
   NO: X YES: DATE WAS OR WILL BE SOLD:

   (c) Does this invention relate to technology that is or will be covered by a SIG (special interest group)/standard/ or specificati n?
   NO: X YES: Name of SIG/Standard/Specification:

   (d) If the invention is embodied in a semiconductor device, actual r anticipated date of tapeout?

EXHIBIT A

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(e) If the invention is software, actual or anticipated date of any beta tests outside Int l _____

6. Was the invention conceived or constructed in collaboration with anyone other than an Intel blue badge employee or in performance of a project involving entities other than Intel, e.g. government, other companies, universities or consortia? NO: _X_ YES: _____ Name of individual or entity: _____

7. Is this invention related to any other invention disclosure that you have recently submitted? If so, please give the title and inventors: _____No_____

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PLEASE READ AND FOLLOW THE DIRECTIONS ON HOW TO WRITE A DESCRIPTION OF YOUR INVENTION

Please attach a page to this form, DATED AND SIGNED BY AT LEAST ONE PERSON WHO IS NOT A NAMED INVENTOR, to provide a description of the invention, and include the following information:

1. **Describe in detail what the components of the invention are and how the invention works.**
2. **Describe advantage(s) of your invention over what is done now.**
3. **YOU MUST include at least one figure illustrating the invention. If the invention relates to software, include a flowchart or pseudo-code representation of the algorithm.**
4. **Value of your invention to Intel (how will it be used?).**
5. **Identify the closest or most pertinent prior art that you are aware of.**
6. **Who is likely to want to use this invention or infringe the patent if one is obtained and how would infringement be detected?**

***HAVE YOUR SUPERVISOR READ, DATE AND SIGN COMPLETED FORM**

DATE: 2/14/00 SUPERVISOR: _____

BY THIS SIGNING, I (SUPERVISOR) ACKNOWLEDGE THAT I HAVE READ AND UNDERSTAND THIS DISCLOSURE, AND RECOMMEND THAT THE HONORARIUM BE PAID

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1. Describe in detail what the components of the invention are and how the invention works.

An array of surface-emitting LED (light-emitting diodes) is manufactured with a 2-dimensional array of the different structures, such as the Red-Green-Blue array where the individual color LED pixel is in the shape of a stripe having an active area whose length is several times greater than its width. The normal optical properties of these LEDs is that the emitted radiation would be in an isotropic, close to a Lambertian, pattern. This does not favor any one direction or orientation over another, and may be the ideal arrangement for some display uses. However, in certain key applications, optical efficiency can be greatly enhanced by the introduction of a light-directing layer in front of the LEDs in order to preferentially increase the brightness in a certain direction over other directions.

An example of an application for this type of display would be in signage, where the observers looking at the sign are confined within a narrow range of viewing in one direction (eg vertical plane) such as road-side signs, elevated signs in public places, etc., which would require as wide a viewing angle as possible in the orthogonal (horizontal) plane.

The design makes use of an array of cylindrical lenses placed close in front of the LED array. Each lens relates to an individual colored pixel LED structure, and acts as a collector for the emitted light. By using a cylindrical lens, with the long axis of the lens aligned with the long direction of the LED, the light emitted from the LED in the plane containing the long axis is not focussed, and the light emitted in a plane perpendicular to the long axis is focussed by the curvature of the lens. The amount of focussing is dependent on the geometry of the LED surface, the cylindrical lens shape and its separation from the LED.

A schematic view of the optical layout is shown in Fig 1, which is a cross-section view of the arrangement, sectioned perpendicular to the long axis of the LEDs.

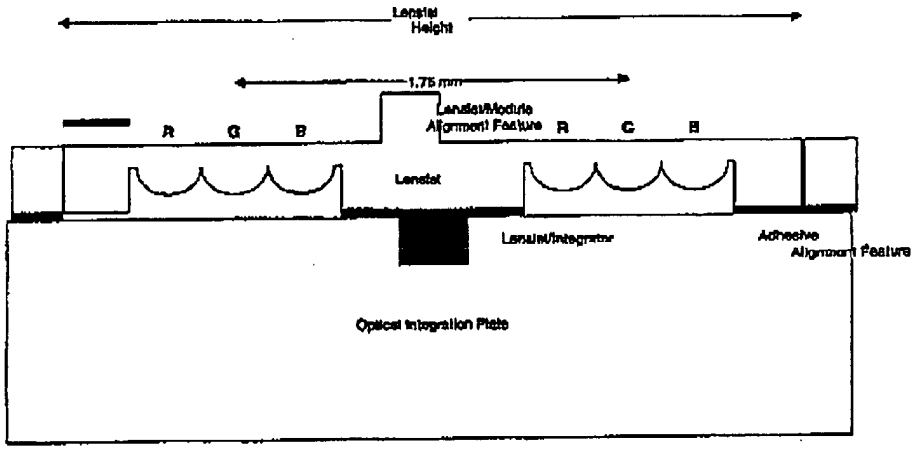

Fig 1 Cross-section view of LED array, lenslet plate and Optical faceplate.

The lenslet plate, with typical feature sizes of 1mm, and thickness 1 or 2 mm, is constructed from an optical grade thermoplastic material such as acrylic or polycarbonate. The lenslet plate might also be molded glass. It contains the lens structure as well as mechanical features for positioning and alignment of the lenses to the LED structure. The lenslet plate may be formed by extrusion, compression molding or injection molding, depending on the choice of material, the overall sizes required for the application, and the tolerances allowed on feature position and surface finish.

Assembly to the Optical integration plate is by means of epoxy bond.

Assembly of the LED structure to the lenslet plate is by a continuous optical bond, and utilizes molded features in the lenslet plate for precise alignment of the LEDs to the lenses.

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A detailed view of a single LED and associated lens is shown in Fig 2.

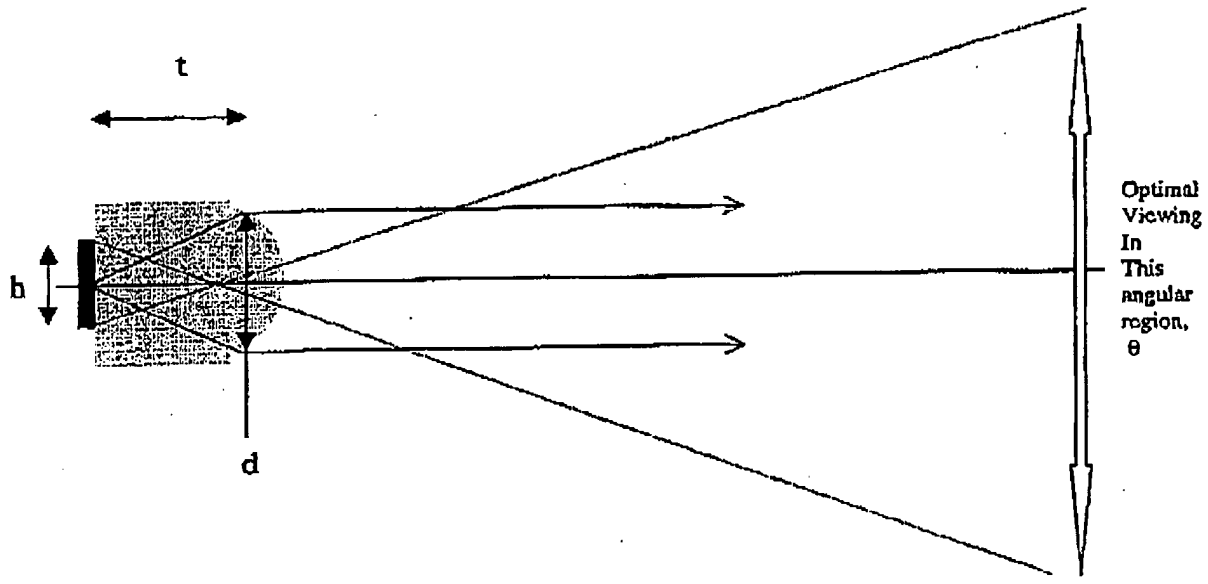

Fig 2. Detailed view of single LED and lens

Viewing angle, θ, is controlled by:

$$\theta = 2 \times \arctan (h / 2t)$$

This practical limit must be greater than the viewing angle range expected for the display. I.e. the angle included by the smallest observer looking at the top of the display and the tallest observer looking at the bottom of the display.

A front view of a portion of the RGB display and the associated lenslet structure, shown superimposed, is in Fig 3. This view shows that the predominant factor in the optical gain caused by the lenslets is the increase in fill factor. To a first order the gain is:

$$G = T \times d / h$$

Where T= transmission of the lenslet material.

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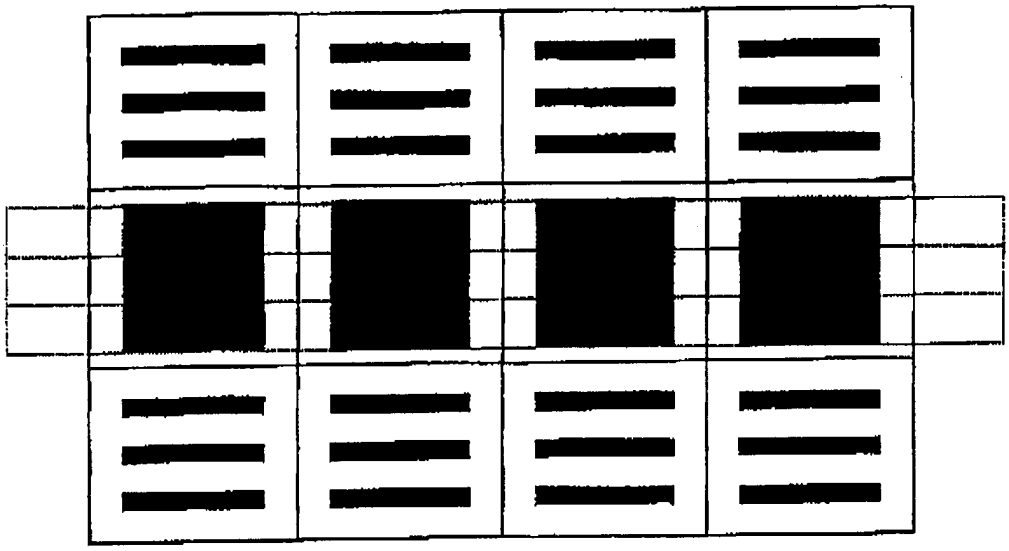

Fig. 3 Front view of display – Optical Gain effect

Key attributes of this invention are:

- The cylindrical lens arrangement is simple to manufacture in plastic substrate. Polycarbonate or Acrylic are examples of optical grade plastic materials that might be used. Molded glass might also be used.
- The cylindrical shape, oriented parallel to the long direction of the LED emitters, provides for efficient control of illumination, and maximum optical gain.
- Displays may be produced with customized directional illumination patterns, by indexing the position of the lens array relative to the LED array. As an example, if the lenslets centers are displaced downward from the pixel centers, then the central illumination direction maximum (for optimum viewing) will be located downward.
- Lenslet plates may be designed and fabricated to match other pixel designs, featuring sub-pixels layed out in a different pattern than that shown here.
- Very large arrays, which subtend large angles at the observer, may be constructed with illumination patterns which vary across one dimensions of the array, in order to preserve the far field illumination pattern of all parts of the display. This will have the effect of optimizing the illumination uniformity of all parts of the display. This can be achieved by producing a lenslet structure which has a pitch slightly less than the pitch of the display active elements.
- Contrast enhancing features will be necessary and can be incorporated into this design form, primarily by introducing low transmittance and low reflectance surfaces for all non-lens surfaces.

2. Value of your invention to Intel (how will it be used?).

As an integral part of the PLED device, the lenslet array allows the display performance to be tailored to various applications. With the use of the lenslet array, the application of the LED display can be extended to applications not previously envisioned. – outdoor displays, increased lifetime requirements, higher contrast needs.

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TOTAL P.09

3. Identify the closest or most pertinent prior art that you are aware of.

Lenticular arrays have been used in rear projection screens for the purpose of tailoring the illumination patterns in front of the screens. Usual form is a 2 dimensional circular lens array (Fresnel lens) as the rear illumination has circular symmetry. In some cases, cylindrical (Fresnel) lenses might be used in order to shape the illumination pattern preferentially in one direction.

6. Who is likely to want to use this invention or infringe the patent if one is obtained and how would infringement be detected?

Any display manufacturer, not limited to the PLED technology, OLED and LCD displays could use this invention. Infringement would be detectable by examination of the physical display panel.(It is likely that the examination of the panel would have to be destructive to confirm that the infringement exists)

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